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Program Review 1983-84

Northern Forest Research Centre

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PROGRAM REVIEW 1983-84

NORTHERN FOREST RESEARCH CENTRE
CANADIAN FORESTRY SERVICE
ENVIRONMENT CANADA
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The Canadian Forestry Service
Environment Canada

The Canadian Forestry Service (CFS) is the principal source of federal expertise in forestry. Its general objective is to promote the wise management and use of Canada's forest resources for the economic, social, and environmental benefit of Canadians. The following are the main functions of the CFS:

1. providing coordinated federal policies to promote forest industry development and better resource management;
2. providing scientific and technical leadership through research and development;
3. providing and analyzing national and international information and statistics as a basis for policy;
4. aiding in developing and certifying codes and standards of product performance;
5. protecting Canada's forests from foreign pests;
6. supporting provincial forest renewal programs to ensure permanent viability of the forest resource;
7. fostering the potential use of the forest resource for energy; and
8. contributing to the environmental objectives of the Department of the Environment.

A number of federal agencies are involved in forestry programs, and a Federal Forestry Sector Strategy Committee has been established to coordinate federal forestry activities. The CFS has been designated the lead agency.

In September 1982 the Canadian Forestry Service assumed responsibility for regional economic development from a forestry standpoint. In this context the service is required to negotiate federal-provincial forest renewal agreements of intensive forest management practices to meet the objective of the federal forestry sector strategy. As a result, the CFS is also involved in the development of economic profiles and studies to identify regional and national needs and development opportunities.

The Canadian Forestry Service is composed of a headquarters unit, six forest research centers, and two national institutes. The forest research centers are responsive to regional priorities and maintain close liaison with the respective provincial government forestry departments. They also participate in, and frequently lead, national programs. The national institutes provide the focus for programs of national scope. The headquarters unit comprises three directorates: Research and Technical Services, which plans, directs, and coordinates the research and development programs and technical services of the CFS; Forestry Relations, Economics, and Development, which handles forestry relations with universities, industry, and other governments, economic analyses, as well as the coordination of the forestry development and employment stimulation programs; and Finance, Planning, and Administration, which manages the support services of the CFS in planning and program evaluation, finance, administration, and human resources management.

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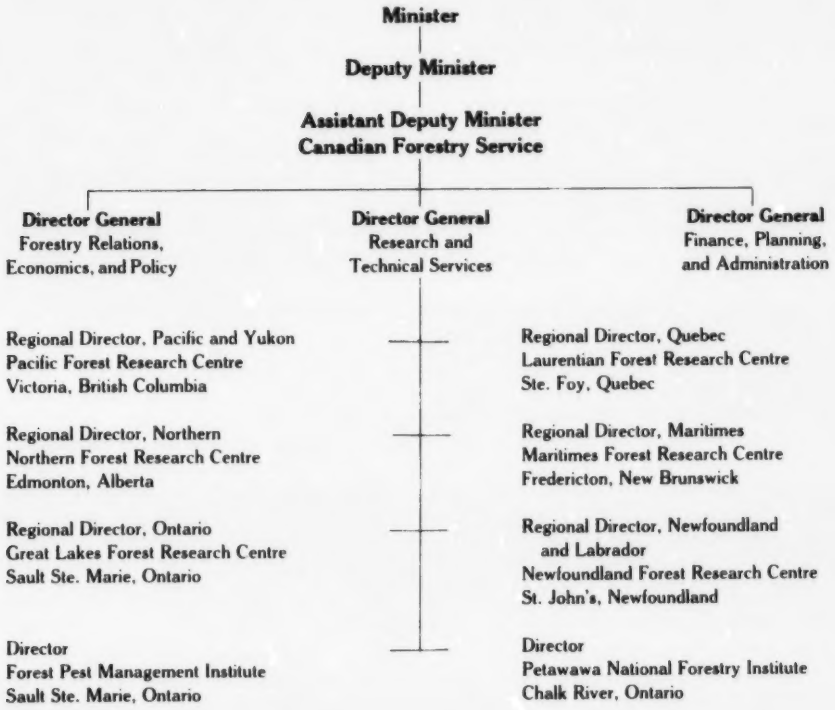

Le service canadien des forêts
Environnement Canada

Le Service canadien des forêts (SCF) réunit la majorité des spécialistes fédéraux en foresterie. Son objectif général est de promouvoir l'aménagement et l'utilisation judicieux des ressources forestières du Canada pour le plus grand bien économique, social et environnemental des Canadiens. Voici les principales fonctions du SCF:

1. fournir des politiques fédérales coordonnées afin de favoriser l'expansion de l'industrie forestière et l'amélioration de la gestion des ressources;
2. fournir une orientation scientifique et technique par la recherche et le développement;
3. fournir et analyser l'information et les statistiques nationales et internationales qui serviront de base aux politiques;
4. aider à la mise au point et à la certification des codes et des normes en matière de performance des produits;
5. protéger les forêts canadiennes en luttant contre les ravageurs étrangers;
6. appuyer les programmes provinciaux de régénération forestière afin d'assurer la viabilité permanente des ressources forestières;
7. parrainer l'utilisation éventuelle des ressources forestières pour la production d'énergie; et
8. adhérer aux objectifs environnementaux du ministère de l'Environnement.

Divers organismes fédéraux participent aux programmes forestiers, et un comité de la stratégie forestière fédérale a été créé pour coordonner les activités fédérales en matière de foresterie. Le SCF a été désigné organisme directeur.

Depuis septembre 1982, le SCF assume la responsabilité du développement économique régional dans le domaine forestier. A ce titre, il doit conclure des ententes fédérales-provinciales, relatives à la régénération forestière, sur des méthodes de gestion intensive des forêts afin d'atteindre les objectifs de la stratégie forestière du Canada. Le SCF doit conséquemment participer à la mise au point de profils et d'études économiques afin de cerner les besoins sur les plan régional et national, de même qu'aux possibilités de développement.

Le SCF comprend une administration centrale, six centres de recherches forestières et deux instituts nationaux. Les centres de recherches forestières doivent répondre aux impératifs régionaux et entretenir une liaison étroite avec les ministères provinciaux des Forêts. Ils participent également à des programmes nationaux dont ils assument fréquemment la direction. Les instituts nationaux sont les foyers des programmes d'envergure nationale.

L'Administration centrale comprend trois directions générales: Recherches et Services techniques, dont le rôle consiste à planifier, diriger et coordonner les programmes de recherche et développement ainsi que les services techniques du SCF; Relations, Economie et Développement, qui s'occupe des relations forestières avec les universités, l'industrie et les autres gouvernements, d'analyses économiques ainsi que de la coordination des programmes de développement forestier et de création d'emplois; et Finances, Planification et Administration, qui dirige les services de soutien du SCF dans la planification, l'évaluation des programmes, les finances, l'administration et la gestion du personnel.

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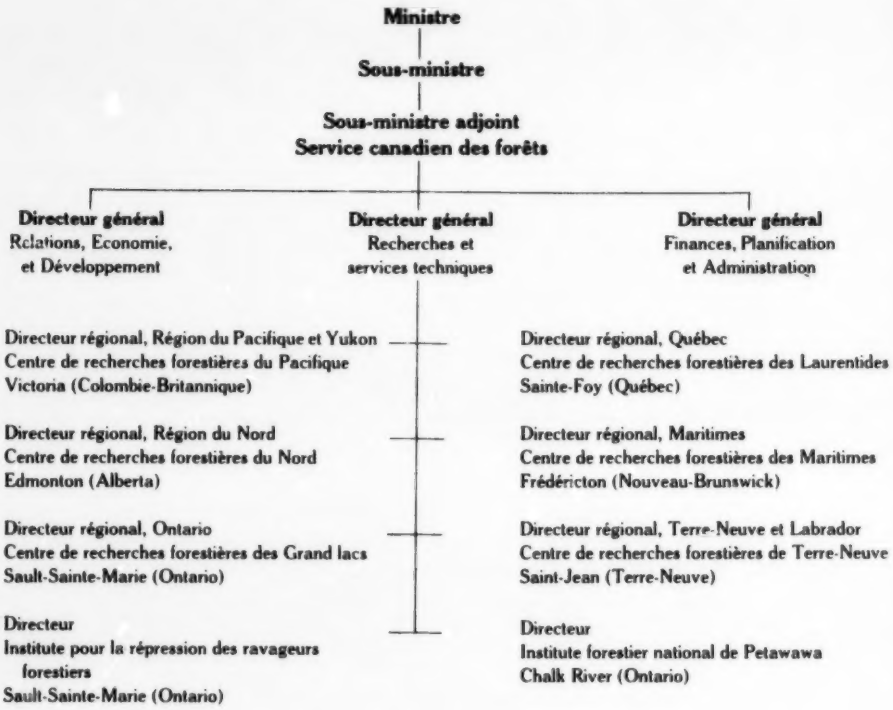

CONTENTS

	Page
Director's Report	2
Environmental Forestry Research	
NOR-7 Impact of airborne pollutants on forests	5
NOR-13 Forest hydrology and microclimate research	6
NOR-22 Remote sensing applications	6
NOR-23 Ecological land classification of national parks	8
NOR-28 Environmental impact assessment and peatland ecology	8
NOR-31 Climatic studies	9
NOR-32 Reduction of damage from LRTAP and other atmospheric pollution	10
NOR-33 Scientific and technical information	10
NOR-34 Forest biomass as an energy source (ENFOR)	11
NOR-52 Analytical services laboratory	12
Forest Resources Research	
NOR-4 Yields of managed stands	14
NOR-5 Fire management systems and guidelines	15
NOR-10 Silviculture investigations	16
NOR-12 Tree improvement	18
NOR-53 Computing and data processing services	19
Forest Protection	
NOR-1 Detection and appraisal of forest insects and diseases	21
NOR-9 Insect and vegetation management systems	22
NOR-35 Tree disease research	23
Regional Development	
NOR-3 Forest resource economics, statistics, and planning	25
NOR-29 Forest resource data	25
NOR-54 Management and common support services: regional development program	26
NOR-36 Forestry development agreements: program planning	26
Administration	
NOR-51 Financial, administrative, and support services	28
Public Information	29
Appendixes	
A — Organizational chart	31
B — Staff listing	32
C — Expenditures	36
D — Cost-shared agreements	37
E — Contracts let or supervised	38
F — Publications	42

Director's Report

The Northern Forest Research Centre (NoFRC), located in Edmonton, Alberta, is responsible for fulfilling the federal role in forestry research, development, and technology transfer in the three prairie provinces—Alberta, Saskatchewan, and Manitoba—and the Northwest Territories. This report on our programs reflects the progress made during the fiscal year 1983-84 in achieving work objectives.

Our research activities are organized under three programs: Environmental Forestry Research, Forest Resources Research, and Forest Protection Research. In late 1982 NoFRC assumed responsibility for the development and implementation of a new generation of federal-provincial forestry agreements in the three prairie provinces. These activities are being carried out under the Regional Development Program. Administrative services and building maintenance personnel complete the total staff of 125, which is supported by an operating budget of about $7 million. During 1983-84 we continued to strengthen our program planning system by preparing an operational plan to guide program development during the 5-year period from 1984-85 to 1988-89.

Achievements in our research and regional development programs during the 1983-84 fiscal year are outlined in the main body of the text; organization, staff listing, expenditures, cost-shared agreements, contracts, and publications are detailed in the appendixes (A to F). Major program accomplishments and activities are outlined below.

Negotiations with Manitoba, Saskatchewan, and Alberta resulted in the identification of programs and funding to be included in the proposed federal-provincial forestry agreements. A $27 million Canada-Manitoba Forest Renewal Agreement involving major programs in forest renewal, intensive forest management, and applied research and technology transfer was signed on March 15, 1984. The agreement provides 14 new person-years, thereby enabling the CFS suboffice in Winnipeg to expand to 18 staff members during the 1984-85 fiscal year. It is anticipated that a $28 million Canada-Saskatchewan Forest Resource Development Agreement will be signed by midsummer 1984 and will be followed by the signing of a $23 million Canada-Alberta Forest Resource Development Agreement by fall of 1984. A new suboffice was established in Prince Albert, Saskatchewan, in the fall of 1983 as an initial step in providing enhanced forestry research and regional development in the province.

NoFRC assumed responsibility for the administration of forestry projects under the Environment 2000 job creation program. A total of 4.5 person-years was made available to help us implement the program in the prairie provinces and Northwest Territories. We anticipate being able to support about 60 forestry projects at a cost in excess of $2.5 million.

Several new initiatives were pursued to enhance the impact of our research and technology transfer programs on the management of the forest resource in the prairie provinces and Northwest

Territories. First, a Canada-Saskatchewan Memorandum of Understanding (MOU) concerning the Coordination of Forest Research was signed by the responsible federal and provincial ministers in July 1983. Secondly, NoFRC and the Agriculture and Forestry Department of the University of Alberta signed a MOU dedicated to closer cooperation in research and education. Finally, the Senior Regional Advisory Committee, chaired by the Regional Director of Forestry, met in late 1983 to discuss ongoing and proposed research programs and to advise on future program direction and priorities. Nearly all projects received medium to very high priority ratings from provincial and university representatives, suggesting that NoFRC has been successful in addressing relevant R & D needs.

NoFRC receives about 10 000 requests for information annually. Approximately 35 000 copies of Information Reports and other technical publications, 5 000 journal article reprints, 30 000 pest leaflets, and 30 000 copies of regional Ecotour booklets are distributed annually to various users. In 1983-84, 12 Information Reports, 10 Forest Management Notes, 1 Forestry Report and 37 journal articles and miscellaneous publications were published.

A.D. Kiil
Regional Director of Forestry

Environmental Forestry Research

PROJECT NOR-7

Impact of airborne pollutants on forests

Objectives: To determine the impact of air pollutants from the extraction and processing of natural resources on forest vegetation and soils; to develop diagnostic techniques to assess the effects of pollutants both singly and in combinations on the forest system; to investigate the distribution and impact of radionuclides in vegetation and soils around uranium mining and milling operations.

Achievements: Descriptive studies on the pattern and impact of pollutant deposition have been carried out in the Athabasca Oil Sands area, near two sour gas processing plants in west-central Alberta, and around the two mining and smelting operations at Flin Flon and Thompson, Manitoba. Laboratory and field studies on soils and both higher and lower plants have resulted in the development of biomonitoring techniques, some of which show promise for future application and others of which are being refined. Studies on the natural environmental and biotic factors that influence pollutant uptake by or impact on boreal forest plant species have been initiated. Preliminary results indicate that further studies, particularly on mixtures of pollutants (metals, SO_2, O_3, NO_3) and elemental sulfur, are required before it will be possible to predict the long-term impact of air pollution on forest systems. Detailed studies on the deposition of pollutants and resultant changes in soil chemistry are under way. An investigation of the distribution of radionuclides in the forest environment surrounding two abandoned uranium mining and milling operations is also being carried out.

Impact assessment and preliminary results of both field and laboratory studies have been presented to Canterra Energy Ltd., Gulf Canada, provincial environment departments, and other appropriate agencies. Articles were published on the biochemical, physiological, and ecological aspects of air pollution impact on plant and soil systems.

1984-85 objectives: To publish journal articles on the influence of pollutant deposition or uptake on plant communities, soil chemistry and biology, lichen communities and physiology, and vascular plant physiology; to prepare information reports on the distribution and impact of sour gas processing and on uranium mining and milling and radionuclides in the terrestrial environment; to continue to measure the rate and effect of pollutant deposition on soil chemistry and subsequent plant response; to continue studies on the influence of SO_2 on jack pine; to continue to investigate the extent and mechanisms of radionuclide transport into forested areas.

Studies:

Assessment of air pollution impact on forest systems

Impact of air pollution mixtures on forest vegetation and soils

Transport of airborne radionuclides released during uranium mining and milling operations and their effects on forest vegetation and soil

PROJECT NOR-13

Forest hydrology and microclimate research

Objectives: To provide forest managers with practical management prescriptions and guidelines that will stabilize or improve the quantity, quality, and delivery time of water from forested areas.

Achievements: Three subbasins (Cabin. Middle, and Twin) of the Marmot Experimental Watershed in the Kananaskis River valley, Alberta, have been calibrated. A commercial harvest of the Cabin subbasin did not increase sediment in the stream but did increase annual streamflow by about 30 mm. Over 2000 circular openings, one tree-height in diameter, were cleared on the Twin subbasin. These clearings contain about twice as much snow at peak accumulation as the uncleared areas between them. Streamflow from the Twin subbasin is being evaluated against that of the Middle subbasin, which has not been harvested.

Numerous clearings less than 0.4 ha were created in aspen forest on the Streeter Experimental Watershed in the northern Porcupine Hills, Alberta. These were expected to retain snow on the upper slopes and to allow the meltwater to infiltrate the soil and appear as local spring flow. The result was a 48% increase in water yield during the 6 years since the treatment. The study will be terminated during 1984.

A U.S. Forest Service procedure for predicting the effects of forest harvesting activities on annual streamflow has been adapted for use in Alberta. The procedure predicts the long-term annual yield of ungauged catchments within 10% of actual.

1984-1985 objectives: To provide forest managers with practical management prescriptions and guidelines that will stabilize or improve the quantity, quality, and delivery time of water from forested areas; to investigate and evaluate the effects of traditional and nonstandard forest clearing practices on microclimate and soil moisture as they affect regeneration, establishment production, and rotation duration.

Studies:

Research coordination in the Alberta watershed research program: Marmot and Streeter experimental basins

Vegetation manipulation—disposition of snow in forest clearings

PROJECT NOR-22

Remote sensing applications

Objectives: To evaluate, develop, and apply new remote sensing and interpretation techniques for forest inventories and environmental management purposes in collaboration with center colleagues, other federal agencies, provincial governments, educational institutions, and industry; to develop improved forest management information systems and apply the data bases in simulation models to test various management strategies; to provide advisory services in survey design, interpretation methods, and analyses.

Achievements: A joint presentation entitled "Computer mapping for biomass inventories" was made to the Sixth International Symposium on Automated Cartography. A report on the use of satellite imagery for operational mapping of all burned forest land in the Northwest Territories was submitted to the Forestry Statistics and Systems Branch. Procom-2 imagery mapping equipment was acquired.

The requirements for forest inventories north of 60°N were reviewed with the Pacific Forest Research Centre and the Department of Indian Affairs and Northern Development. The most effective forest inventory contributions in the Territories from this project have been large-scale photo sampling expertise and the development and provision of an upgraded computer assisted mapping data base, analysis, and information management capability.

Modifications to the large-scale photo pod were completed, and specifications for a computerized intervalometer were completed. Operational trials were flown in the Yukon, and a total of seven large-scale photo sampling computer programs were written for technology transfer to Northern Development Forest Resources (Yukon). Contract supervision work was performed in Toronto, and large-scale photo sampling collaboration was reviewed with the Newfoundland Forest Research Centre. Large-scale photography and assistance were provided to Alberta, and data analyses are now in progress. A journal paper, "Mapping the distribution of aspen defoliation using Landsat color composites", was published.

Briefings on remote sensing applications were provided to official visitors from China, Alberta, and Indian Affairs and Northern Development. Meetings of the Canadian Advisory Committee on Remote Sensing and the Alberta Advisory Committee on Remote Sensing were attended, and a working group survey and report were completed for the Canadian committee annual report. Scientific authority responsibilities were assumed for biomass survey contracts.

1984-85 objectives: To prepare an Information Report on computer mapping; to develop specifications for integration of a digital image analysis system; to prepare a Forest Management Note on Procom-2 for gross change mapping; to prepare an Information Report on environmental assessments with multilevel remote sensing interpretation for change and trend predictions; to publish an Information Report on large-scale photo use for regeneration assessments; to write, update, and modify microcomputer programs for additional applications; to cooperate with Alberta and the Yukon in operational trials of large-scale photo sampling in a multistage remote sensing context.

Studies:
Remote sensing and technical advisory services
Development and application of large-scale photo and image analysis techniques to forestry

PROJECT NOR-23

Ecological land classification of national parks

Objectives: To provide ecological land classification of national parks in western Canada that includes landform, soil, vegetation, and wildlife resource components, with an interpretation of the data collected for land-use planning and management.

Achievements: An ecological land classification of Banff and Jasper national parks has been completed. Volumes I, II, and III and a map supplement were published in 1983. A supplement to the Banff-Jasper reports, entitled *Using ecological resource inventory*, has been written. Fieldwork has been completed in Kootenay National Park and Mt. Revelstoke and Glacier national parks, and reports have been prepared.

1984-85 objectives: To complete and terminate the ecological land classification of Kootenay and Mt. Revelstoke-Glacier national parks project.

Study:
Ecological land classification of Kootenay and Mt. Revelstoke-Glacier national parks

PROJECT NOR-28

Environmental impact assessment and peatland ecology

Objectives: To assess the impact of proposed industrial developments (such as pipelines, roads, and oil and gas exploration north of 60° latitude) and to recommend measures to minimize or mitigate their impact; to investigate the ecology of peatlands by studying their dynamics and development.

Achievements: Impact assessments were carried out recently in connection with the Beaufort Sea hydrocarbon development, the Norman Wells pipeline, road construction in Banff National Park, and a number of smaller projects. Future research will depend on short-term notices of requests for environmental impact assessments received from senior management of Environment Canada, the federal Cabinet, and other federal agencies or departments.

Natural resource inventories have been carried out on Bylot Island-Eclipse Sound, Axel Heiberg Island, Banks Island, and at Bathurst Inlet, NWT, in connection with the proposed establishment of national parks.

The ecology of wetland development is being studied in the boreal zones of Alberta, Saskatchewan, and Manitoba. Each year about 60 different peatlands have been investigated, and hundreds of plant and peat samples have been collected to determine the fossil plant association and the botanical origin of the peat. The calorific value and radiocarbon age have been obtained for some samples.

1984-85 objectives: To continue assessment of environmental impacts of proposed industrial development; to undertake peatland ecology work in Saskatchewan.

Studies:
Environmental assessment and impact of developments on the terrestrial environment
Peatland development and ecology

PROJECT NOR-31

Climatic studies

Objectives: To provide information to assess the impact of climate on forest vegetation and soils, including the effect of short-term and long-term climate fluctuations on forest biomass productivity; to represent the CFS and NoFRC on advisory committees, including those associated with the Canadian Climate Program.

Achievements: Two ENFOR-related Information Reports were published: *Impact of climatic variation on biomass accumulation in the boreal forest zone: selected references* and *How climate affects tree growth in the boreal forest.* Other papers published include "Richmond Longley and climatic variability in Canada" and "History and development of the Canadian Climate Program." Annual and seasonal temperature and precipitation trends and variations were studied for over 100 long-term climate stations in the boreal forest zone of the prairies and Northwest Territories. An Information Report, entitled *A proposed method for preliminary assessment of erosion hazards in west-central Alberta,* was published on the use of soil infiltration methods from earlier hydrology studies at Hinton, Alberta. Further analyses and extraction of data from a climate study on clear-cut areas near Hinton were undertaken. Assistance was provided to Forintek Canada Corp. in obtaining tree-ring samples from four 100-year-old sites in Alberta for comparison with 200+-year-old samples collected in the area, as the older samples showed slow growth during their first 100 years, which may be related to growth during the later part of the Little Ice Age.

Following a forest-wildlife workshop on research and management within the St. Regis lease area near Hinton, a package was developed that listed all studies (past and present) carried out by NoFRC on the lease area.

1984-85 objectives: To complete a report on the climatic variation in the boreal forest zone of the prairies and Northwest Territories; to prepare reports on the growing season climate of four clear-cut areas studied for the influence of stand edge on seedling growth; to prepare reports in cooperation with Forintek Canada Corp. on tree-ring and climate-growth relationships; to represent the CFS and NoFRC on various advisory committees or working groups, including serving as chairman of the Canadian Committee on Climate Fluctuations and Man and of the Canadian Climate Program Task Force on Climate Proxy Data.

Study:
Impact of climatic variation on boreal forest biomass production

PROJECT NOR-32

Reduction of damage from LRTAP and other atmospheric pollution

Objectives: To determine the origin and extent to which long-range transport of air pollutants (LRTAP) is degrading terrestrial ecosystems, with specific reference to soils and vegetation; to investigate the distribution and impact of radionuclides in vegetation and soils around uranium mining and milling operations.

Achievements: Studies of simulated acid rain deposition on vegetation were initiated. Reports of the work performed in the Thompson and Flin Flon areas have been prepared and submitted to scientific journals. Vegetation and soil sampling was initiated at the Gunnar tailings site near Uranium City, NWT. As part of a joint baseline study with the Environmental Protection Service and the National Water Research Institute, a series of vegetation and soil samples were collected in the Wollaston Lake area. Radioanalytical procedures have been developed for the sequential determination of the major radionuclides.

1984-85 objectives: To terminate the project and transfer the objectives to NOR-7.

Studies:

Impact of air pollutants from major regional sources on forest vegetation and soils

Transport of airborne radionuclides released during uranium mining and milling operations and their effects on forest vegetation and soils

PROJECT NOR-33

Scientific and technical information

Objectives: To provide relevant and timely information to all user clientele (scientific, technical, and public) at a reasonable cost, using the complete range of available communications techniques and information.

Achievements: NoFRC has evolved into the principal regional source of information relating to the management and protection of commercial and recreational forests. Research emphasis currently is being placed on intensive forest management practices (particularly as related to regeneration, tree improvement, insect and disease control in plantations, and stand tending), watershed management, fire management systems, remote sensing, economics, resource data analyses, land classification, toxic substances, and environmental concerns.

In 1983-84, 12 Information Reports, 10 Forest Management Notes, 1 Forestry Report, and 37 journal articles and miscellaneous publications were published. A Program Review 1982-83 was prepared and printed, and 22 Pest Leaflets were revised and reprinted. Calgary-Golden, Calgary-Regina, and Regina-Winnipeg Ecotours were reprinted in quantities for several years' supply. Color photograph postcards for reprint requests and general messages were prepared and printed. Forestry Report 27, *Manitoba forestry facts*, received an award of excellence from the Society for Technical Communication, Eastern Ontario Chapter.

The integration of word processing equipment with other typesetting and information systems was investigated. As a result, an AES word processing system was acquired that communicates with the AM Varityper phototypesetter that was also acquired.

About 10 000 requests for information are received annually through the mail and by telephone and personal inquiries. Approximately 35 000 copies of Information Reports and other technical publications, 5000 journal article reprints and miscellaneous publications, 30 000 pest leaflets, and 30 000 copies of regional Ecotour booklets are distributed annually on a request basis. Demand for regionally produced publications remains steady. Nearly 1500 organizations and individuals are on a computerized mailing list and either are automatically sent all publications or three times a year are sent a notice of recent publications. Advice and publications were provided to NoFRC staff involved in preparation and tending of displays. A staff newsletter and publications progress report were produced monthly.

1984-85 objectives: To assist the research staff in the preparation, publication, and distribution of scientific, technical, and public information.

Study:
Scientific and technical information

PROJECT NOR-34

Forest biomass as an energy source (ENFOR)

Objectives: To develop methodology to quantify the amount of forest biomass available for energy conversion in the region; to assess its cost in use; to determine the physical and socioeconomic impact of its availability and use.

Achievements: ENFOR is the acronym for the ENergy from the FORest program funded by the federal Department of Energy, Mines, and Resources and partly administered by the Canadian Forestry Service. Since the program began in 1978, contracts have been awarded to private organizations for studies on biomass availability, biomass harvesting, environmental impacts of production and harvesting, and intensive silviculture for increasing biomass production. The following contracts were undertaken in NoFRC's region in 1983-84 (they are also listed in Appendix E, which shows contractor, project title, expenditure, and scientific authority): 1. Determination of biomass and nutrient content in trees, ground vegetation, and soils of aspen stands in Alberta (P-205), 2. Green-volume (basic) specific gravity of tree species in the prairie provinces (P-255), 3. Compilation of forest biomass inventories for Manitoba (P-270), and 4. Nondestructive sampling of noninventoried areas and nonsampled cover types in the prairie provinces and NWT (P-273). In addition, two service contracts were completed based on earlier work: one under project P-149, to undertake a dendroclimatological reconstruction based on tree-ring material from the Duck Mountains in Manitoba, and another on statistical compilations of forest land areas by township.

Information Reports were published entitled *How climate affects tree growth in the boreal forest* (P-149), *Impact of climatic variation on biomass accumulation in the boreal forest zone: selected references* (P-150), and *Biomass equations for six major tree species of the Northwest Territories* (P-169). Four Forest Management Notes were published entitled *FORTRAN subroutines for biomass computation* (P-92), *Harvesting forest biomass with a Dika side cutter* (P-163), *Weight tables for important tree species in the Northwest Territories* (P-169), and *Conversion of tree volume to biomass in the prairie provinces* (P-92). A paper on "Computer mapping for biomass inventories" (P-148) was presented at the Sixth International Symposium on Automated Cartography, and a user's manual for the system was prepared. A presentation was given at the Fifth Bioenergy R & D Seminar, entitled "Energy potential of conifer species in the prairie provinces."

1984-85 objectives: To complete project P-205; to complete reports for projects P-23, P-102, P-148, and P-207; to plan ENFOR-related reports to complement earlier contract reports; to start three new studies, as listed below:

1. Adaption of FORCYTE for application in Alberta aspen stands (P-314),
2. Biomass and energy potential of tree species in Manitoba (P-315), and
3. Noninventoried forest area update by prairie township with Landsat imagery (P-316).

Studies:

An assessment of the energy potential of forest biomass in the prairie provinces and Northwest Territories

Development of integrated biomass prediction equations for the Western and Northern Region

PROJECT NOR-52

Analytical services laboratory

Objectives: To provide analytical services to individual scientists at NoFRC and cooperators for the elemental and related analyses of soil, vegetation, and associated materials.

Achievements: Many of the research activities at NoFRC require analytical expertise that is not available with the individual projects. The analysis of soils, waters, and plant materials has been provided on an ongoing basis through the Analytical Laboratory facilities.

1984-85 objectives: To maintain an adequate Analytical Services Laboratory to provide elemental and other related analyses of soils, vegetation, and water.

Study:

Analytical services laboratory

Forest Resources Research

PROJECT NOR-4

Yields of managed stands

Objectives: To develop and assess silvicultural options and treatments for increasing yields of managed stands; to provide forest management agencies with improved techniques and models for growth and yield prediction for the commercially important cover types and management options in the prairie provinces and NWT.

Achievements: Numerous long-term studies that have been initiated in the past to provide prescriptions for spacing, thinning, and fertilization of lodgepole pine, jack pine, white spruce, and trembling aspen in the region are being monitored; the results are being published as they become available.

During 1983-84 two papers, entitled "Natural lodgepole pine in west-central Alberta: Regeneration stocking" and "Fertilization", were published in the proceedings of the Fourth Annual International Workshop on Lodgepole Pine: Regeneration and Management (U.S. For. Serv., Gen. Tech. Rep. PNW-157).

A survey to determine the incidence of damage (insect, disease, and small mammals) in juvenile lodgepole pine has been completed, the data were analyzed, and a journal submission was prepared. An Information Report was published entitled *Influence of stand edge on planted white spruce and lodgepole pine.*

Laboratory determinations of essential nutrients associated with the lodgepole pine fertilization study were completed, and the data were analyzed for N shifts and content changes in the horizons of two Luvisol soils following fertilization. A detailed study plan has been developed for a thinning and fertilization experiment in semimature lodgepole pine, and a suitable stand was selected for this purpose.

A workshop on growth and yield forecasting was held at NoFRC for personnel from provincial governments (Alberta, Saskatchewan, and Manitoba), the forest industry, and forestry consultants, chiefly to demonstrate STEMS (Stand and Tree Evaluation and Modeling System), which has now been calibrated to provide reasonable yield estimates for aspen and jack pine in this region. Assistance was provided in the organization of an international symposium on lodgepole pine management.

Thinning studies in jack pine (Manitoba) and aspen (Saskatchewan) and a study on early development of aspen stands (Saskatchewan) were remeasured. Data from the latter were analyzed, and a paper entitled "Logging practices and subsequent development of aspen stands in east-central Saskatchewan" was presented at the annual meeting of the Canadian Poplar Council in Saskatoon.

1984-85 objectives: To cooperate in a problem analysis of R & D needs in stand tending, growth, and yield for Manitoba, Saskatchewan, and Alberta in relation to the forestry development agreements and memorandums of understanding; to present a paper on fertilization at the Lodgepole Pine Symposium and to organize a postsymposium field tour; to prepare a paper on

biological damage in young lodgepole pine and one on tree growth response to seismic line clearing in western Alberta; to expand the lodgepole pine spacing trials in the Gregg Burn; to calibrate STEMS for white and black spruce and lodgepole pine; to publish reports on the effects of fertilization on 30- and 70-year-old lodgepole pine and on soil nutrient budgets and N/S ratios on two Luvisols; to establish new thinning and fertilization experiments in semimature lodgepole pine.

Studies:

Growth and yield of five commercially important native species in Alberta, Saskatchewan, and Manitoba

Stand modeling of the growth and development of important forest types in the prairie provinces

Transformation and movement of applied fertilizer elements (N, P, S) in selected lodgepole pine stands

Fertilization of established lodgepole pine stands

Fertilization and thinning of semimature lodgepole pine stands

PROJECT NOR-5

Fire management systems and guidelines

Objectives: To provide standards, operational guidelines, and decision aids to land managers that will reduce, at an acceptable cost, damage and loss from forest fires while considering the related economic, ecological, and social factors.

Achievements: Seen-area maps were prepared for 11 detection towers in Riding Mountain National Park. Twenty fire weather stations were inspected in Saskatchewan to establish reliability of weather data. A sensitivity test of the Xedar infrared scanner was conducted in Saskatchewan.

Alberta Forest Service aerial-attack summaries were collated and computer analyzed. Two experimental burns were conducted in Elk Island National Park. Fuel, weather, and fire behavior data were analyzed for a semimature jack pine stand in central Alberta. Fieldwork was initiated in Jasper National Park to describe forest fuels. A laboratory retardant application system was tested and calibrated.

Air tanker retardant drop pattern data have been summarized, and an initial-attack planning model was developed. Several fire history maps of Alberta have been prepared. Data have been organized and analyzed for a fire behavior study in the black spruce-lichen woodland fuel complex. An annotated bibliography on the Canadian Forest Fire Danger Rating System is nearing completion.

In late March 1984 a National Fire Research Workshop was held at the Petawawa National Forestry Institute. The workshop provided an excellent forum for discussing a wide range of concerns and viewpoints on issues of interest to fire researchers.

NoFRC cohosted the Intermountain Fire Council annual meeting in Banff, Alberta. Nine seminars and workshops were presented by the fire research staff to client agencies throughout the

year. Fire research staff attended meetings of and participated on several relevant committees, including the Western Region Fire Weather Committee, Central Region Fire Weather Committee, National Fire Danger Working Group, Canadian Council of Resource and Environment Ministers Co-op Supply Task Force, Canadian Committee on Forest Fire Control, Northwest Territories Fire Management Program Committee, and Alberta Forest Service Strategy and Tactics Task Force.

Several lab demonstrations were conducted for touring schools and colleges. All major clients in the region were visited to discuss long-term fire research direction. An initial version of a 60-minute videotape on the Porter Lake project was completed.

Twenty-two reports were prepared or published, including 10 articles in the Forestry Report on *Fire*, two Forest Management Notes (*Tables for determining spring Drought Code starting values in west-central and northern Canada* and *An inexpensive, portable forest firefinder*), two Information Reports (*Jack pine regeneration following postcut burning and seeding in central Saskatchewan* and *Jack pine regeneration following postcut burning and seeding in southeastern Manitoba*), three papers in conference proceedings, one trade journal article, one scientific journal paper, and three miscellaneous reports.

1984-85 objectives: To conduct an experimental burning project in the lowland black spruce fuel type of northern Alberta; to continue fieldwork on forest fuels in Jasper National Park; to collect additional lightning fire origin data; to prepare a regional fire research strategy with particular reference to the FDAs and MOUs; to develop a problem analysis in operations research for forest fire management; to publish 10 research papers.

Studies:
Fire behavior in boreal forest fuels
Evaluation and planning of fire detection, surveillance, and communications systems and methods
Evaluation of the role of fire in forest and intermingled vegetation in the prairie provinces, Rocky Mountains, and far North
Decision-aid models for use in fire management
Fire danger and behavior rating in forest and rangeland environments

PROJECT NOR-10

Silviculture investigations

Objectives: To formulate planning tools and guidelines for promoting an effective federal role in improving standards for management of regional forest resources, particularly in the areas of prompt regeneration, seedling production, storage, and field performance, site productivity, tree physiology, and data bank and model development.

Achievements: Between 1958 and 1978 this program concentrated on assessing and developing site preparation techniques (including scarification and prescribed burning), developing and assessing container planting systems (including work on container type and size), and developing guidelines for rearing containerized seedlings, covering a range of production criteria from seed through to nutrition and hardening-off of stock.

Since 1979 there has been a shift in emphasis away from the original concerns of site preparation and development of container systems to the actual field performance of the stock being produced and the development of prescriptions that would integrate available knowledge and present it for use by managers. There is continuing complementary research in soil fertility, site productivity, and seed and seedling physiology as well as participation in national projects such as mechanization of silviculture and forest statistics.

Achievements in 1983-84 included continued assessment of plantation field performance across the region and contract duties in cooperation with the Alberta Forest Service on research emphasizing effects of stock size and planting period for lodgepole pine and white spruce. More emphasis was placed on silviculture research and technology transfer in Manitoba and Saskatchewan as a result of the addition of professional and technical staff in Winnipeg.

Commitments to bare-root and container nursery research and liaison were maintained, with significant work in monitoring container and greenhouse operations, soil nutrition and management, and stock handling and storage techniques. A nursery operations research officer was hired to give further emphasis to this work.

During 1983, endogenous growth regulators in seedlings were studied, and physiological testing of container stock during dormancy and hardening was continued. Emphasis is being placed on hardening and dormancy mechanisms in coniferous seedlings, with research into the role of nutrition and other physiological aspects of these processes.

Work on a field guide for recognition and management of ecosystems in western Alberta was continued in cooperation with the Alberta Forest Service and is nearing completion.

Also during 1983, the mechanization of silviculture study was continued in cooperation with the national study. Initial emphasis was placed on an equipment inventory and familiarization with equipment assessment techniques, and a major equipment test area was developed in Saskatchewan in cooperation with the Great Lakes Forest Research Centre and the Saskatchewan Department of Parks and Renewable Resources. NoFRC sponsored a workshop on the mechanization of silviculture in March 1984.

1984-85 objectives: To maintain research liaison and technology transfer in nursery and greenhouse production, handling, and storage; to continue research into cold hardening and dormancy of seedlings and to develop a research program in seed and seedling physiology; to finalize a field guide for forest ecosystem management in western Alberta; to initiate a field study on the effects of soil modification during logging and site preparation; to increase the emphasis on silviculture research and technology transfer in Manitoba and Saskatchewan; to participate in establishing R & D and technology transfer priorities under the memorandums of understanding; and to continue working with national programs such as FORSTATS (FORestry STATisticS) and NACMEC (NAtional Committee for the MEChanization of Silviculture).

Studies:
Nursery operations
Nursery soil fertility and seedling growth
Development of silviculture data base and management tools for forest resource planners

Field performance of planted stock
Forest tree seed and seedling physiology
Forest ecology and site productivity
Silvicultural research and technology transfer, Manitoba and Saskatchewan

PROJECT NOR-12

Tree improvement

Objectives: To improve the quality of reforestation stock for use by forest land managers by breeding or identifying and introducing genetically superior populations of commercial forest species; to produce genetically superior seed or cuttings of seedlings of jack pine in cooperation with forest management agencies for production of genetically superior planting stock.

Achievements: A Forest Management Note, *Selection for eastern Manitoba jack pine seed orchards*, was published reporting a gain of 30% in volume growth and 12% in stem quality rating from selection based on 10-year family-test results. Individual trees were selected from the 40 selected families for use as parents to produce control-pollinated seedlings for the main eastern Manitoba jack pine seed orchard.

Five hundred and sixty-one grafts of the selected eastern Manitoba families were planted in another seed orchard at the Pineland Forest Nursery, in cooperation with the Manitoba Forestry Branch. This seed orchard should contain nearly 1200 grafts by the summer of 1985. Planning is under way for expanded seed orchard development in Manitoba under the Canada-Manitoba Forest Renewal Agreement.

The western breeding district family test in Saskatchewan was measured following the 10th growing season after planting.

Clone bank grafting in 1984 reduced the number of additional grafts required to 37. There are 2102 grafts alive in the clone bank, and grafts to fill 1046 unstocked clone bank positions are lined out or in pots. Scions for seed orchard grafting are obtained from grafts in the clone bank.

Fireguards were cleared and tilled around all family-test plantations, with assistance from the Manitoba Forestry Branch for some Manitoba plantations. Tornado damage in one test plantation was reduced by staking.

1984-85 objectives: To prepare reports on the 1972 seed orchard and on family-test results in Saskatchewan and Manitoba; to plan cooperative tree improvement research and development for Manitoba and Saskatchewan; to staff a seed orchard development position in Manitoba; to arrange a contract for vegetative propagation research; to carry out controlled pollination with selected family-test trees to produce seed orchard trees; to begin construction of a tree improvement greenhouse in Manitoba; to measure Scots pine and black spruce provenance experiments.

Studies:
Provenance tests for coniferous species
Breeding jack pine for the northern region. I. First selection cycle

PROJECT NOR-53

Computing and data processing services

Objectives: To provide problem-solving and other consulting and programming services using the in-house and University of Alberta computing facilities; to provide keypunch-verify and data entry services; to offer courses to staff in computer basics, use of computing facilities such as the HP 9825, Tektronix graphics, and RAMS mapping system, and introductory and advanced FORTRAN, Minitab, and Datatrieve; to provide staff at NoFRC, other agencies, and outside users with computer-related service and advice.

Achievements: A feasibility study was conducted into word-processing equipment, and approval was given by CFS headquarters for the purchase of an AES system. A second study gained approval for purchase of an AM Varityper phototypesetter. A third study brought Treasury Board approval for a VAX/VMS 11/750 computer with a streamer tape drive, 450 megabyte fixed disk, and 4 megabytes of memory. A removable 300 megabyte disk was also approved. Six Columbia personal computers, which will be distributed to various sections, were acquired. CFS headquarters purchased three Rainbow personal computers for the Regional Development Group; one will go to Prince Albert, one will go to Winnipeg, and the other will be used at NoFRC. All of the equipment was received and installed during the fiscal year.

Several courses were attended by the Computer Centre staff in preparation for the arrival of the VAX. An inventory program with several modules to handle various Stores functions was written and implemented. A local area networking system (Develcon) was purchased and is being put on-line. A Xerox laser printer was purchased and is a welcome addition to the computing hardware; it has several fonts and can print 12 pages per minute. Several thousand processes are being handled each month, and about 50 persons, including many of the summer students, are involved in one way or another with computing and data entry at NoFRC.

1984-85 objectives: To continue to supply and expand services as required by NoFRC; to receive, test, and install new programs, updates, and versions on all systems and personal computers; to assist with the training for and installation of the personal computers at the various sites in the region; to supply programming and consulting assistance required by NoFRC and other projects.

Study:
Computing and data processing services

Forest Protection

PROJECT NOR-1

Detection and appraisal of forest insects and diseases

Objectives: To gain an improved knowledge of major forest insects and diseases for the purpose of understanding and minimizing damage attributable to these organisms; to contribute to a national overview of important pests and their implications.

Achievements: Annual surveys of important pests and conspicuous forest damage have been conducted since 1941. Infestations of major insect and disease outbreaks have been monitored, and their impact on the forest resource has been assessed. Major insect problems monitored in 1983-84 included the mountain pine beetle, spruce beetle, spruce budworm, jack pine budworm, and forest tent caterpillar. Dwarf mistletoe, pine stem rusts in tree nurseries and plantations, and Dutch elm disease are the principal diseases under investigation. Permanent plots to measure the impact of major pests on forest stands were remeasured.

Many special surveys for particular pests were conducted, including mountain pine beetle population survival studies and surveys to detect new or introduced pests under NoFRC's plant quarantine responsibilities.

A pest extension program was conducted, and more than 1500 inquiries were processed. Information booths on tree pests were displayed on several occasions to the public, and pest leaflets and other publications were distributed. Workshops, lectures, and talks on forest pests were presented on 30 occasions. The regional forest insect and disease reference collections were maintained and upgraded, and identification services were provided. Taxonomical and biological studies of sawflies are continuing. Field tests were conducted with spruce budworm pheromones for monitoring populations and with mountain pine beetle attractants for monitoring and controlling beetle populations.

Results of survey activities were published in an Information Report, *Forest insect and disease conditions in Alberta, Saskatchewan, Manitoba, and the Northwest Territories in 1982 and predictions for 1983*, and a Forest Management Note, *Forest insect and disease conditions in Saskatchewan in 1983 and predictions for 1984*. Assistance was provided in collecting material for a pictorial guide to forest and shade tree insects of the Canadian prairies. A journal article was published entitled "Mapping the distribution of aspen defoliation using Landsat color composites."

1984-85 objectives: To survey, map, and report on major forest pest infestations such as the mountain pine beetle, spruce beetle, forest tent caterpillar, spruce budworm, and jack pine budworm; to monitor other noteworthy forest insects and diseases; to provide diagnostic and advisory services; to produce a draft of a standard survey methodology manual for the region; to assess operational use of satellite imagery; to conduct impact and damage appraisal studies of major pests and collaborate in the preparation of the pictorial guide to forest and shade tree insects.

Studies:
Forest insect and disease survey
Sawfly systematics
Control and damage impact of insects injurious to trees and shrubs

Forest insects: diagnostic and taxonomic services
Damage appraisal of major forest pests

PROJECT NOR-9

Insect and vegetation management systems

Objectives: To evaluate the use of herbicides, pesticides, and pheromones as tools in forest management; to evaluate the relative importance of various environmental factors in early mortality of reforested pine stands; to assess the impact of white spruce seed and cone insects and to develop methods for controlling them.

Achievements: Survival in established herbicide plots was monitored, and expanded field testing of Velpar in granular and liquid form as well as trials involving an unnamed pre-emergent herbicide were conducted. Conifer release on heavy clay soils was poor, but good control of competing vegetation was achieved on light sandy soils.

Extensive field testing of synthetic pheromones for *Proteoteras* (boxelder twig borers) and *Petrova* (pitch nodule makers) was conducted, and the formulations were refined. Large numbers of insects in both genera were caught in the traps, but the baits were not specific: three *Proteoteras* species and two *Petrova* species were caught. A journal article was published entitled "Identification of three species of *Proteoteras* (Lepidoptera: Tortricidae) attacking shoots of Manitoba maple in the Canadian prairies." An additional 50 small plots were established in young lodgepole pine stands in the Hinton area of Alberta, while nearly 800 similar plots were maintained in jack pine plantations in the Sandilands Forest Reserve in Manitoba. Mortality during 1982-83 was monitored for all lodgepole pine plots established in 1981 and 1982. Preliminary results indicate that mortality rates increase as the age of young stands increases. If present trends continue, approximately half of the original trees will have died after 30 years from stand establishment, 7 years after cutting.

Injections of Bidrin and Metasystox R into white spruce trees by Mauget pressurized capsules gave ineffective control of seed and cone insects. Soil-drench treatments involving Temik 10 G, Temik 15 G, and Furadan were also ineffective.

1984-85 objectives: To continue evaluation of liquid and granular formulations of Velpar and other herbicides for conifer release and to conduct further assessments of the synthetic pheromones; to monitor the survival of lodgepole pine in 62 study areas near Hinton, Alberta; to further intensify efforts to obtain color photographs and information for an illustrated handbook on forest and shade tree insects of the region.

Studies:
Chemical controls of pests and vegetation in managed forests
Evaluation of mortality in stands of young trees in plantations and scarified areas

PROJECT NOR-35

Tree disease research

Objectives: To gain improved knowledge of the biology, pathology, and epidemiology of selected tree diseases, especially forest tree rusts and other diseases of intensively managed young conifer forests; to determine the effects of ice nucleating agents on cold tolerance of seedlings and to develop effective overwintering guidelines to enhance field performance; to maintain and upgrade the mycological herbarium and a fungal culture collection; to conduct short-term taxonomic investigations of selected forest fungi.

Achievements: Principal areas of research under investigation in the past year were western gall rust of lodgepole pine and jack pine, Armillaria root rot of young conifer forests, effects of ice nucleating agents on cold tolerance of conifer seedlings, and blue stain fungi and other microorganisms associated with mountain pine beetles. A study of bioactive metabolites of forest disease pathogens is in progress in cooperation with chemists at the University of Alberta (U of A). Cooperative arrangements with the U of A Forest Science and Plant Sciences departments and the Alberta Forest Service have been established to conduct joint research and to supervise thesis research of two graduate students.

This project is supported partly by a grant from the Alberta Forest Research Trust Fund (Armillaria root rot investigation), a contract with the Alberta Forest Service (western gall rust investigation in relation to the lodgepole pine improvement program), and a strategic grant from NSERC (investigation of blue stain fungi associated with mountain pine beetles).

1984-85 objectives: To continue investigation of western gall rusts, Armillaria root rot, effects of ice nucleating agents on cold tolerance of conifer seedlings, and microorganisms associated with blue stain fungi; to prepare and publish several journal papers and Information Reports.

Studies:
Forest tree rusts of western North America
Forest diseases: research and technical transfer services
Canker, dieback, and mortality of juvenile forest trees and amenity species

Regional Development

PROJECT NOR-3

Forest resource economics, statistics, and planning

Objectives: To provide socioeconomic information to regional forestry programs for rational policy formulation and program development by identifying and estimating the major economic benefits, product flows, and impacts of the forest resource and its utilization in the Western and Northern region; to provide input to regional forestry programs by participating as a team member in interdisciplinary studies; to provide economic statistics and guidelines on costs and benefits of the forest resource, impacts of forest management, marketing, and related socioeconomic data.

Achievements: The principal focus of this project has been an assessment of the forest-based economy of the prairie provinces. Work continued on the last of a series of reports on detailed surveys of the primary wood-using industries of the prairie provinces and NWT. Social and economic data were reviewed for the development of materials required for the negotiation, ratification, and implementation of forest resource development agreements with the prairie provinces. Silviculture data, including a national silviculture questionnaire, were collected and analyzed. Project members participated in the implementation of a natural resources subagreement in the NWT and played an integral role in the development of agreements with Manitoba, Saskatchewan, and Alberta.

1984-85 objectives: To prepare the remaining Information Reports and a journal article on changes in the forest industry in the region during the 1970s; to develop and implement a forest industry survey to update the primary wood-using industry data base in the region; to provide increased economic analysis in support of forestry research and development in the region; to prepare a framework for evaluating the forest resource development agreements; to complete cataloguing and conversion of selected NoFRC permanent sample plots (PSP) for inclusion in a national PSP inventory.

Studies:
Forest resource economics, statistics, and planning

PROJECT NOR-29

Forest resource data

Objectives: To collect and interpret forestry statistics at the regional and national levels in order to provide advice and guidelines to resource managers and researchers in support of forest policy decision making.

Achievements: This is a regional project that formed part of the Canadian Forest Resource Data Program, which has been coordinated across the country by the Forestry Statistics and Systems Branch located at the Petawawa National Forestry Institute. Regional statistics have been collected for inclusion in national reports on forest inventories, seed collection, and nursery facilities. Silviculture statistics for Canada were collected and analyzed at NoFRC for the 5-year period 1975-80, and a report summarizing the data was published.

1984-85 objectives: To terminate the forest resource data project.

Study:
Forest resource and operations statistics in the prairie provinces and Northwest Territories

PROJECT NOR-54

Management and common support services: regional development program

Objectives: To plan and implement a work program to meet the objectives of the Regional Development Program; to manage the person-year and financial resources allocated to the Regional Development Program.

Achievements: The organizational structure for the Regional Development Program, including suboffices in Prince Albert and Winnipeg, was developed and implemented. All new positions in the Regional Development Program were filled. Discussions and negotiations were undertaken with officials of the governments of the prairie provinces aimed at the conclusion of federal-provincial forestry agreements. The Canada-Manitoba Forest Renewal Agreement was signed, and significant progress was achieved in discussions with Saskatchewan and Alberta.

1984-85 objectives: To negotiate, sign, and implement the Canada-Alberta and Canada-Saskatchewan forest resource development agreements; to implement the Canada-Manitoba Forest Renewal Agreement; to continue the development and implementation of employment stimulation programs in the forest sector; to provide administrative and financial services as required.

Study:
Program manager, regional development

PROJECT NOR-36

Forestry development agreements: program planning

Objectives: To assess the impact of regional, national, and international economic and social events on regional development of the forest industry; to discuss, negotiate, and implement federal-provincial forestry agreements in Alberta, Saskatchewan, and Manitoba; to develop and implement forestry employment stimulation programs in the prairie provinces and the NWT.

Achievements: Projects funded from the Unemployment Insurance Commission's Forestry Employment Stimulation Program were implemented and terminated. The Canada-Manitoba Forest Renewal Agreement was developed, approved by Cabinet, and signed by the two governments. Negotiations with Saskatchewan on a similar agreement neared conclusion, and

negotiations were going well with Alberta. Technical support was supplied for the NWT natural resources subagreement. Coordination was provided for federal forestry initiatives and programs in the prairie provinces and NWT with the regional development mandate. The implementation of the Environment 2000 program was begun.

1984-85 objectives: To implement the Canadian-Manitoba Forest Renewal Agreement; to provide technical input to the NWT natural resources subagreement; to provide input in program development for other federal initiatives related to forest resources; to manage and administer the Environment 2000 program in the region.

Studies:
Forestry development agreements (program planning)
Forestry development agreements (Winnipeg suboffice)
Forestry development agreements (Prince Albert suboffice)

Administration

PROJECT NOR-51

Financial, administrative, and support services

Objectives: To provide a system of financial control and accountability in accordance with statutory and regulatory requirements; to provide general administrative support services, including materiel management, records management, engineering, building maintenance, secretarial and office services, and vehicle fleet management.

Achievements: Office support and central registry units continued to maintain a high level of service to the lab. The acquisition of a new word processing system will enhance the overall capabilities for office support and will enable a greater variety of tasks to be undertaken.

1984-85 objectives: To continue to provide efficient administrative and financial support services.

Public Information

Objectives: To provide the center with a public information service; to act as the channel through which contact is maintained with the general public and national, regional, and local news media; to produce booklets, news releases, exhibits, and audiovisuals; to handle telephone and written inquiries from the general public.

Achievements: The NoFRC public information program is carried out by NoFRC staff with the advice and assistance of the Public Affairs Office, Western and Northern Region, Environment Canada.

Public information activities increased considerably in 1983-84, in part due to Smoky Lake, Alberta, being declared the honorary Forestry Capital of Canada during 1983 National Forest Week. NoFRC staff participated in ceremonies and contests at Smoky Lake and tended displays at Wetaskiwin, Smoky Lake, and Edmonton in Alberta and at Hudson Bay in Saskatchewan. At West Edmonton Mall in Edmonton and at Hudson Bay, NoFRC staff in attendance conducted pest clinics and handed out publications and approximately 7000 Colorado blue spruce seedlings in total. News releases, public service announcements, and materials for tray liners, grocery bags, and milk cartons were prepared by Public Affairs staff. NoFRC staff also participated in radio and television interviews in Edmonton to promote Forest Week.

During Canadian Environment Week, the NoFRC display was set up at Heritage Mall in Edmonton. The NoFRC display and award-winning raft were featured in a Government of Canada display during Klondike Days in Edmonton. Pest leaflets and 8000 Colorado blue spruce seedlings were distributed. In November, NoFRC staff tended the display during a federal Information Fair in Grande Prairie, Alberta.

Articles on NoFRC activities were prepared by Public Affairs staff for Environment Canada and external publications. A draft communications plan was prepared by CFS and Public Affairs staff for public information activities related to the Canada-Manitoba Forest Renewal Agreement. News material was prepared by NoFRC staff to distribute at signing ceremonies for the agreement on March 15, 1984.

1984-85 objectives: To increase the level of public information activities carried out by and for NoFRC staff; to plan and implement publicity for signings of the federal-provincial development agreements.

APPENDIX A

NORTHERN FOREST RESEARCH CENTRE
ORGANIZATION CHART
(as of March 31, 1984)

PUBLIC INFORMATION
(Environment Canada)

REGIONAL DIRECTOR
A.D. Kiil

ADMINISTRATION
A.M. Mont

ENVIRONMENTAL FORESTRY RESEARCH
Program Manager
Dr. S.S. Malhotra

- NOR-7 -- Impact of airborne pollutants (Dr. P.A. Addison)*
- NOR-13 -- Forest hydrology (Dr. R.H. Swanson)
- NOR-22 -- Remote sensing (W.C. Moore)
- NOR-23 -- Ecological land classification (W.D. Holland)
- NOR-28 -- Environmental impact (S.C. Zoltai)
- NOR-31 -- Climatic studies (Dr. J.M. Powell)
- NOR-32 -- Transport of air pollutants (LRTAP) (vacant)
- NOR-33 -- Scientific and technical information (J.K. Samul)
- NOR-34 -- Forest biomass (ENFOR) (Dr. J.M. Powell)
- NOR-52 -- Analytical services lab (vacant)

* Project leader in parentheses

FOREST RESOURCES RESEARCH
Program Manager
R.M. Waldron

- NOR-4 -- Yields of managed stands (Dr. I.E. Bella)
- NOR-5 -- Fire management systems (D.E. Dubé)
- NOR-10 -- Silviculture investigations (L.G. Brace)
- NOR-12 -- Tree improvement (Dr. J.I. Klein)
- NOR-53 -- Computing and data processing (W. Chow)

FOREST PROTECTION
Program Manager
H.J. Johnson

- NOR-1 -- Detection and appraisal of insects and diseases (Dr. B.H. Moody)
- NOR-9 -- Insect and vegetation management systems (W.G.H. Ives)
- NOR-35 -- Tree disease research (Dr. Y. Hiratsuka)

REGIONAL DEVELOPMENT
Program Manager
Dr. M.J. Heit

- NOR-3 -- Forest resource economics, statistics, and planning (D.M. Boylen)
- NOR-29 -- Forest resource data (vacant)
- NOR-36 -- Forestry development agreements (S. Price)
- NOR-54 -- Support services: regional development (Dr. M.J. Heit)
- -- Winnipeg suboffice
- -- Prince Albert suboffice

Staffing	Person-years
Management	5.0
Scientific & professional	51.6
Technical	38.0
Administrative & foreign service	8.0
Administrative support	16.0
Operational	9.0
CEIC students	13.5
Total	141.1

APPENDIX B

NORTHERN FOREST RESEARCH CENTRE
STAFF LISTING
(as of March 31, 1984)

Regional Director of Forestry:	A.D. Kiil Secretary - K.W. Conaty
Program Managers	
Environmental Forestry Research:	Dr. S.S. Malhotra Secretary - R.B. Bown
Forest Resources Research:	R.M. Waldron Secretary - R.B. Bown
Forest Protection:	H.J. Johnson Secretary - K.W. Conaty
Regional Development:	Dr. M.J. Heit Secretary - R.B. Bown
Regional Chief of Finance and Administration:	A.M. Mont
Public Information:	Public Affairs Office, Western and Northern Region, Environment Canada

ENVIRONMENTAL FORESTRY RESEARCH
Dr. S.S. MALHOTRA

Project	Title	Professional Staff	Technical Staff
NOR-7	Impact of airborne pollutants on forests	Dr. P.A. Addison (Project leader) Dr. M.J. Apps Dr. D.G. Maynard	O.K. Fenn R.G. Radford J.I. Ridgway
NOR-13	Forest hydrology and microclimate research	Dr. R.H. Swanson (Project leader) Dr. P.Y. Bernier Dr. G.R. Hillman	Z. Fisera P.A. Hurdle E.B. Robson
NOR-22	Remote sensing applications	W.C. Moore (Project leader) R.J. Hall	T.J. Walsh
NOR-23	Ecological land classification of national parks	W.D. Holland (Project leader)	D.T. Allan M.D. Fairbarns
NOR-28	Environmental impact assessment and peatland ecology	S.C. Zoltai (Project leader) J.D. Johnson	M.W. Ali

Project	Title	Professional Staff	Technical Staff
NOR-31	Climatic studies	Dr. J.M. Powell (Project leader)	N.B. Schultz
NOR-32	Long-range transport of air pollutants (LRTAP)	Project leader (vacant)	
NOR-33	Scientific and technical information	J.K. Samoil (Project leader) G.B. Turtle	D.J. Adams
NOR-34	Forest biomass as an energy source (ENFOR)	Dr. J.M. Powell (Project leader) Dr. T. Singh	
NOR-52	Analytical services laboratory	Project leader (vacant) Y.P. Kalra	J. Shuya

FOREST RESOURCES RESEARCH
R.M. WALDRON

NOR-4	Yields of managed stands	Dr. I.E. Bella (Project leader) Dr. J. Baker H.S. Grewal Dr. R.C. Yang	V.S. Kolabinski S.J. Lux
NOR-5	Fire management systems and guidelines	D.E. Dubé (Project leader) M.E. Alexander Z. Chrosciewicz G.P. Delisle Fire operations (vacant) Fire suppression (vacant)	M.E. Maffey C.J. Ogilvie R.M. Smith
NOR-10	Silviculture investigations	L.G. Brace (Project leader) W.J. Ball[a] Dr. I.G.W. Corns Dr. I.J. Dymock Dr. I.K. Edwards E. Harvey H. Zalasky Silviculture forester (vacant)	F.M. Dendwick J.R. Dyck[b] J.R. Gorman J.J. van Dyk N.R. Walker

[a, b] Winnipeg suboffice.

Project	Title	Professional Staff	Technical Staff
NOR-12	Tree improvement	Dr. J.I. Klein (Project leader)	A. Nanka
NOR-53	Computing and data processing services	W. Chow (Project leader) A.W. Irwin T. Tan	L. Hai

FOREST PROTECTION
H.J. JOHNSON

NOR-1	Detection and appraisal of forest insects and diseases	Dr. B.H. Moody (Project leader) Dr. H.F. Cerezke Dr. H.R. Wong	F.J. Emond H.S. Gates M.G. Grandmaison J. Petty G.N. Still D.L. Szlabey R.C. Tidsbury
NOR-9	Insect and vegetation management systems	W.G.H. Ives (Project leader) Forest entomologist (vacant)	J.A. Drouin C.L. Rentz
NOR-35	Tree disease research	Dr. Y. Hiratsuka	P.J. Maruyama

REGIONAL DEVELOPMENT
Dr. M.J. HEIT

Project	Title	Professional Staff	Technical Staff
NOR-3	Forest resource economics, statistics, and planning	D.M. Boylen (Project leader) W.J. Ondro T.B. Williamson	R.A. Bohning J.P. De Franceschi H.M. Stewart
NOR-29	Forest resource data	Project leader (vacant)	
NOR-36	Forestry development agreements: program planning	S. Price J.J. Farrell[c] K. Froning[d] R.G. Newstead	

[c] Prince Albert suboffice.
[d] Winnipeg suboffice.

Project	Title	Professional Staff	Technical Staff
NOR-54	Management and common support services: regional development program	Dr. M.J. Heit (Project leader)	
	Finance officer	E. Weiss	
	Clerk-Secretary (Winnipeg suboffice)		J. Landry
	Clerk-Secretary (Prince Albert suboffice)		K.P. Bacon

ADMINISTRATION

A.M. MONT

Position	Staff
Head, financial services	F. Allen
Senior accounts clerk	S.H. Acheson
Accounts and vehicle clerk	J.L. Wake
Purchasing officer	J.E. Hodgins
Purchasing clerk	T.Y. Avenell
Storesperson	J.C. McLoughlin
Supervisor office services	E.R. de Looper
Registry clerk	A.R. Fulton
Receptionist-typist	T.B. Phillips
Word processor operator	E. Schiewe
Stenographer	S. Ratansi
Librarian	D.J.S. Robinson
Library technician	E.M. Hopp
Photographer	P.S. Debnam
Electronics technician	P. Bihuniak
Head, physical facilities	H. Schoendube
Chief engineer	R.R. Hallette
Maintenance engineers	F.H. Gardner
	A. De Costa
Senior maintenance craftsman	S.T. Colistro
Maintenance craftsman	B.A. Clinton
Groundskeeper	G.M. Schmidt

APPENDIX C

NORTHERN FOREST RESEARCH CENTRE
EXPENDITURES 1983-84

Program area	Person-years[a]	Salaries ($000)	Operations & maintenance[b] ($000)	Capital ($000)	Total ($000)
Directorate (includes Program Directors)	5.0	252.2	131.1	2.2	385.5
Administration	26.0	678.7	569.8	256.7	1505.2
Environmental forestry	34.0	1132.0	335.7	188.6	1656.3
Forest resources	40.0	1185.5	308.2	324.8	1818.5
Forest protection	19.1	736.3	149.4	81.3	967.0
Regional development	17.0	417.7	239.2	13.8	670.7
ENFOR[c]	—	—	310.1	—	310.1
Cost-sharing agreements[d]	—	—	104.8	—	104.8
Job creation	—	—	147.5	—	147.5
Total	141.1	4402.4	2295.8	867.4	7565.6

[a] Includes 13.5 person-years for students and 0.6 person-years for Francophones.
[b] Includes contracts; see Appendix E.
[c] ENergy from the FORest (Project NOR-34) funded by Canada Department of Energy, Mines, and Resources.
[d] See Appendix D.

APPENDIX D

NORTHERN FOREST RESEARCH CENTRE
COST-SHARED AGREEMENTS 1983-84

Funding agency	Program	Project	Operations & maintenance ($000)	R & D contracts ($000)
Alberta Department of Energy and Renewable Resources	Container-seedling planting trials	NOR-10 (Walker)	6.3	—
Alberta Department of Environment	Impact of air pollutants	NOR-7 (Addison)	10.0	—
Canterra Energy Ltd.	Monitoring of sour gas	NOR-7 (Addison)	24.0	—
Energy, Mines, and Resources Canada	Boreal peat resources in the prairies	NOR-28 (Zoltai)	42.0	—
Environment Canada, Parks Canada	Ecological land classification of Kootenay-Revelstoke-Glacier national parks	NOR-23 (Holland)	22.5	—
Total			104.8	—

APPENDIX E

NORTHERN FOREST RESEARCH CENTRE
CONTRACTS LET OR SUPERVISED
AND EXPENDITURES IN 1983-84

Contractor	Title	Amount ($)	Scientific authority
Alan Moss & Associates Ltd. 1334 St. Paul Street Kelowna, B.C. V1Y 2E1	Determination of biomass and nutrient content in trees, ground vegetation, and soil of aspen stands in Alberta (P-205)[a]	400,711	L.G. Brace
Edwards, P.M. 101, 10160 - 83 Avenue Edmonton, Alberta T6E 2C4	Maintenance of forest insect survey material	2,500	W.G.H. Ives
England, C.L. 51068 - Range Road 223 Sherwood Park, Alberta T8C 1C9	Identification of plant macrofossils in peat	3,600	S.C. Zoltai
Fabijan, D.M. 10350 - 154 Street Edmonton, Alberta T5P 2H6	Curation of plant samples collected during 1983 field season	4,000	J.D. Johnson
Forintek Canada Corporation 6620 N.W. Marine Drive Vancouver, B.C. V6T 1X2	Dendroclimatological reconstruction based on material from Duck Mountain, Manitoba	7,500	J.M. Powell

Good, V.E. 6335 Travais Crescent N.W. Calgary, Alberta T2K 3S8	Revision and editing of federal-provincial forest resource development agreements and industrial survey reports	30,000	M.J. Heit
Harder, J. 205, 1628 - 48 Street Edmonton, Alberta T6L 5T2	Performing statistical compilations of forest land areas by township	1,193	W.C. Moore
Kershaw, L.J. 51163 Range Road 204 Sherwood Park, Alberta T8A 3K4	Completion of reorganization of northern vascular plant herbarium	3,000	J.D. Johnson
Lambert, T. 11747 - 91 Avenue Edmonton, Alberta T6G 1B1	Digestion and radiochemical separation of vegetation samples	1,050	M.J. Apps
Le Voir, S.A. 11232 - 40 Avenue Edmonton, Alberta T6J 0R2	Compilation of analytical data	2,000	S.C. Zoltai
Manitoba Data Service 10th Floor 215 Gary Street Winnipeg, Manitoba R3C 3P3	Provision of data analysis services for Manitoba forest inventory	43,000	T. Singh
Peterson, R. 6255 - 112A Street Edmonton, Alberta T6H 3K4	Statistical analysis of forestry data	2,925	T. Singh

APPENDIX E continued

Contractor	Title	Amount ($)	Scientific authority
Reid, Collins and Associates Ltd. 1178 West Pender Street Vancouver, B.C. V6E 3X4	Conducting a worldwide lodgepole pine literature search	9,500	R.M. Waldron
Saskatchewan Research Council 30 Campus Drive Saskatoon, Saskatchewan S7N 0X1	Determination of radiocarbon age of peat samples	3,600	S.C. Zoltai
Sawyer. L. 9132 - 70 Avenue Edmonton, Alberta T6E 0T5	Statistical analysis	4,500	T. Singh
Thompson, E.K. 1517 Knottwood Road North Edmonton, Alberta T6K 2B8	Volcanic ash analysis	5,000	S.C. Zoltai
University of Alberta (J. Beck) Edmonton, Alberta T6G 2J9	Forest economics research needs for the west-central region of Canada[b]	29,238	M.J. Heit
University of Alberta (Office of the Comptroller) Edmonton, Alberta T6G 2E2	Amelioration of subsurface horizons of luvisolic soils through mechanical disruptions[b]	55,305	W.D. Holland

	Environmental impact of herbicide use in North American forestry[b]	14,746	S.S. Malhotra
	Determination of green and dry volume wood densities of prairie provinces/NWT inventory tree species[b]	26,000	T. Singh
University of Calgary (R.W. Martin) 2500 University Drive N.W. Calgary, Alberta T2N 1N4	Effects of elemental sulfur on soil biological properties of forest litter/soil systems[b]	23,490	P.A. Addison
University of Manitoba (J.E. Scholz) 105 Administration Building Winnipeg, Manitoba R3T 2N2	Intrastructural study of host-parasite interactions of western gall rust with hard pines[b]	40,756	Y. Hiratsuka
Woodland Resource Services 10735 - 180 Street Edmonton, Alberta T5S 1G6	Part of ENFOR program (P-273)[a]	157,159	W.C. Moore
	Summary report, "Analysis of integrated utilization of aspen for wood products and energy"	5,000	D.M. Boylen
Total		875,773	

[a] ENergy from the FORest (ENFOR) contract (Project NOR-34).
[b] Program of Research by Universities in Forestry (PRUF) contract.

APPENDIX F

NORTHERN FOREST RESEARCH CENTRE
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(As of March 31, 1984)

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